Boncelles Formation

Unit name: Boncelles Formation

Hierarchical unit name: Rocourt Group (informal unit at the time of composing this LIS-file*) for the deposits on the eastern Hesbaye plateau, consisting from top to base of the Liège Formation, the Boncelles Formation and the Sint-Huibrechts-Hern Formation (proposal by Marion et al., 2018)

Type: Formation

Code: Bn

This LIS file takes into account the latest revision of the stratigraphy in the type area by Marion et al. (2018) and Delcambre (2018), who incorporated the Boncelles Formation in the proposed Rocourt Group, but gave it a different meaning depending on the geographical context. Here we consider in particular the upper 'Chattian' part of the Oligocene sand, following the subdivision by Fourmarier (1934).

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Alternative names: Abbreviation 'BCL' on the geological maps of the Walloon region. Formerly part of 'sables oligocènes indifférenciés' or 'Om (dépôts inférieurs marins (Tongrien?) du système oligocène)' on the old 1/40.000 geological maps (e.g. Forir & Mourlon, 1897).

Status: Formal

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*Note: This LIS file takes into account the latest revision of the stratigraphy in the type area by Marion et al. (2018) and Delcambre (2018), who incorporated the Boncelles Formation in the proposed Rocourt Group, but gave it a different meaning depending on the geographical context. Here we consider in particular the upper 'Chattian' part of the Oligocene sand, following the subdivision by Fourmarier (1934).

Characterising description

The Boncelles Formation forms the fine-grained upper part of remnant Oligocene sand deposits on the eastern Hesbaye and Condroz plateaus, up to the Hautes Fagnes region (= Boncelles Formation sensu stricto, restricted to the 'Chattian').

In the Boncelles type area (Figure 0-1) this lithostratigraphical unit consists of rather homogeneous well-sorted fine grained pale yellow sand, containing decalcified mollusc layers in some locations (= sables supérieurs on Figure 0-2). The top is weathered and rubified, a feature shared with the overlying Graviers liégeois (Liège Formation) (= limons et graviers on Figure 0-2). The base is formed by a thin double layer of red-stained glauconiferous coarse-grained sand with rounded quartz pebbles, overlying more heterogeneous coarser grained sand which is bleached white in colour (= sables

moyens et inférieurs on Figure 0-2), resting on a residual flint deposit at the contact with the Palaeozoic bedrock (= silex on Figure 0-2).

However, according to the latest revision of the Wallonian geological map, the Boncelles Formation in the Boncelles type area on the Condroz plateau south of Liège (Figure 0-1) contains the entire sand sequence, corresponding to the Om unit of the old geological map (Forir & Mourlon, 1897). This Boncelles Formation sensu lato thus includes both 'Chattian' and 'Tongrian' parts, cf.0 Age).

The upper or 'Chattian' part of the Boncelles Formation sensu lato in the Condruzian type locality (= Boncelles Formation sensu stricto) is displaying a rhythmic succession in sets of 30 to 50 cm thickness, consisting of finely stratified sand with cross-bedding at their base and bioturbations at their top, exception made for the rubified top of the section. The sedimentary environment is open marine outside tidal influence, whereas the underlying 'Tongrian' sand has been deposited in tidal environments. The boundary between both units marks a hiatus with reorganisation of the sedimentary environment (Macar, 1934; Sierakowski, 1970).

No sedimentary features were described from other occurrences.

According to the proposal by Marion et al. (2018) the Boncelles Formation on the eastern Hesbaye plateau is restricted to the 'Chattian' part of the eponymous formation occurring on the Condroz plateau south of Liège, the 'Tongrian' part being assigned to the Sint-Huibrechts-Hern Formation. The Hesbayan Boncelles Formation has similar characteristics as the upper, Chattian part of the Condruzian Boncelles Formation, consisting of homogeneous yellow fine grained to silty sand, occasionally containing poorly preserved decalcified molluscs. The contact with the underlying Sint-Huibrechts-Hern Formation is sharp and marked by a horizon with quartz and flint pebbles. The Sint-Huibrechts-Hern Formation can be distinguished by its whitish-grey colour, coarser grain size and slight glauconite content.

The Oligocene sand on the Hautes Fagnes plateau is well-sorted, fine to medium and typically shiny and polished as beach deposits; its colour varies from yellow to bleached white or rubified. It is equally divided in two parts, the lower unit is medium-grained and had its coastline along the northern rim of the Hautes Fagnes plateau, the upper unit is fine-grained and had its coastline further south. Compared to the Boncelles type locality both Hautes Fagnes sand units display more beach sand features, a difference explained by the more proximal coastal setting on the Hautes Fagnes plateau compared to the more distal open marine environment in the Boncelles type area (Demoulin, 1986, 1987, 1989).

Based on this exclusively petrographical data, these units are proposed to correlate with the upper 'Chattian' and lower 'Tongrian' units at the Boncelles type locality and on the eastern Hesbaye plateau. Furthermore, all similar 'Tertiary' marine sand deposits preserved in N Eifel east of the Hautes Fagnes area are assigned to the Chattian 'Kölner Schichten' by German authors (Schäfer & Utescher, 2014)

Type section, type locality

The former Sart-Haguet sand pit in Boncelles forms the type section (134W0011); the former Gonhis (or Les Gonhirs in older documents) sand pit where Rutot (1907) first recorded a Chattian fauna (named Aquitanian by Rutot) can be considered as an auxiliary stratotype (134W0010). The entire 'lambeau de sables oligocènes' at Boncelles forms the type locality (Rutot, 1908; Fraipont, 1908; Destinez, 1909; Fourmarier, 1931, 1934; Ancion & Van Leckwijck, 1947; Calembert, 1954; Sierakowski, 1970; Juvigné et al., 2021a, b) – see Figure 0-1, Figure 0-2 from Sierakowski (1970) and the sand pit profiles by Rutot (1907) on Figure 0-3.

Description upper boundary

The Condruzian Boncelles Formation is unconformably covered by whitish clayey gravel deposits of fluviatile origin, formerly mapped as 'Onx' on the old geological maps (Forir & Mourlon, 1897), currently named the Liège gravels and assigned to the Liège Formation, which predate the incised Meuse river terraces (Juvigné et al, 2021b).

On the eastern Hesbaye plateau (provinces of Liège and Limburg) the Boncelles Formation is either overlain by the Quaternary loam cover or by the gravel of the Liège Formation. However, in the northern Hesbaye ('Vochtig Haspengouw') with more contiguous Paleogene – Neogene deposits, the older 'Tongrian' Sint-Huibrechts-Hern Formation of Lower Oligocene age is covered by the Mid-Miocene Bolderberg Formation; the intervening Boncelles Formation is either absent/eroded or has remained undetected.

On the Hautes Fagnes plateau and the Ardenne – Eifel transition the Oligocene sand is overlain by peat or mostly colluvial gravel.

Description lower boundary

On the Condroz plateau south of Liège – containing the type area - the base of the Boncelles Formation sensu lato consists of a residual clay-with-flint alteration unit, marked 'Sx' for 'Conglomérat à silex' on the old geological maps (Forir & Mourlon, 1897), covering Lower Devonian formations. The detailed topography seems to depend on the degree of weathering of the underlying Lower Devonian siliciclastics (Figure 0-2). However, the Boncelles Formation there has another content than on the Hesbaye plateau: the Condruzian Boncelles Formation sensu lato is encompassing both 'Chattian' and 'Tongrian' strata, the latter being excluded from the Boncelles Formation on the Hesbaye plateau sensu Marion et al. (2018). Hence, the fine-grained 'Chattian' upper part of the Boncelles Formation, corresponding to the Boncelles Formation sensu stricto as defined north of the Meuse, is overlying the coarser-grained and more whitish 'Tongrian' lower part of the Condruzian Boncelles Formation, equivalent to the Sint-Huibrechts-Hern Formation.

Fourmarier (1934) distinguished in this area a 'Chattian' Boncelles Formation from the underlying 'Tongrian' Sart-Tilman Formation. The Fourmarier nomenclature would provide the same meaning to the Boncelles Formation north and south of the Meuse. Nevertheless, this subdivision has not been applied by later authors.

On the Hesbaye plateau the Boncelles Formation is overlying coarser-grained and more whitish strata belonging to the 'Tongrian' Sint-Huibrechts-Hern Formation, assigned to the Lower Oligocene.

On the Hautes Fagnes plateau the fine-grained upper 'Chattian' unit may overlain the lower medium-grained 'Tongrian' unit or directly cover Cambrian bedrock south of the presumed Tongrian coast line (Figure 0-4)

Thickness

The thickness of the Boncelles Formation is 7 -11 m in Sart-Haguet sand pit type locality in Boncelles, for the Boncelles Formation sensu stricto, corresponding to the upper or 'Chattian' part of the formation (cf. Figure 0-2, Figure 0-3). The Boncelles Formation sensu lato (including the underlying sand correlated to the Sint-Huibrechts-Hern Formation) reaches about 20 m in thickness, similar to the maximal thickness reached on the eastern Hesbaye plateau by the Boncelles and Sint-Huibrechts-Hern formations combined (ca 25 m).

On the Hautes Fagnes plateau thickness of both the upper and lower units of the Oligocene sand is limited to 2 to max 5 m.

Due to post-Oligocene erosion the remaining thickness may be more reduced, resulting in limited conservation of the Boncelles Formation sensu stricto.

Occurrence

Geological mapping did not differentiate between the Oligocene sand. Hence, the Boncelles Formation is included either in the Sint-Huibrechts-Hern Formation (e.g. at Maurissen sand pit in Elst) on the Flemish geological maps (Claes et al., 2001) or in 'undifferentiated Oligocene sand' of the geological maps of Wallonia, except for Marion et al., 2018 and Delcambre, 2018 (unpublished), who include the Boncelles Formation in the proposed Rocourt Group on the Hesbaye plateau.

Although the occurrence of the Boncelles Formation sensu stricto (meaning the deposits correlated with the Chattian) is poorly constrained and its known occurrences are limited to within the preservation area of the underlying sand correlated to the Sint-Huibrechts-Hern Formation, its conservation and the Hesbaye plateau is probably linked to dissolution of the underlying Cretaceous. Moreover, its depositional area will not far exceed the western boundary of the Roer Valley Graben Shoulder (Rauw, Beringen and Mal faults, cf. Dusar & Vandenberghe, 2020), along a limit extending further south towards the Liège region. Identified occurrences of the Chattian Boncelles Formation thus seem to be in geographical continuation with the Voort Member of the Veldhoven Formation (see LIS Veldhoven Formation) further north in the Campine. This means that assignment to the Chattian of the Rond Péry mollusc fauna on the adjoining mapsheet Jehay-Bodegnée – Saint-Georges indeed could be questioned (Delcambre, 2018, unpublished).

Linking the Boncelles Formation sensu stricto to the Voort Member of the Veldhoven Formation means also linking to the Köln Formation of the Lower Rhine Graben (Hager, 1980), despite the assumed absence of equivalent Chattian deposits in the Netherlands South Limburg and on the Herve plateau (Demoulin, 1989). Yet, the Oligocene sand deposits on the Hautes Fagnes plateau can equally be subdivided in two units. Although both units represent coastal barrier sand the upper one is consistently finer grained and more deprived of heavy minerals (Demoulin, 1986, 1987). Moreover, its occurrences extend across the Hautes Fagnes culmination up to the Weisser Stein, whereas the lower unit had its coastline along the Spa – Solwaster ridge along the northern flank of the Hautes Fagnes plateau (Figure 0-4). This means that the upper unit represents the latest Oligocene transgression, separate from the previous one which is associated with the Lower Oligocene 'Tongrian' transgression, and that this upper unit may be linked to the upper 'Chattian' part in the Boncelles type area (Demoulin, 1989). It also would mean that Miocene erosion has removed most of the easily erodible Chattian Boncelles Formation.

Regional correlations

The original succession described by Rutot (1907, 1908) for the Sart-Haguet and Gonhis sand pits (Figure 0-3) remains the basis for the stratigraphic subdivision, but was reviewed by Ancion & Van Leckwijck (1947), Ancion & Van Leckwijck, 1947) presented an overview, based on the Sart-Haguet and more northerly Bois St.-Jean sandpits, resulting in different thicknesses for the successive units already recognised by Rutot, from top to bottom:

a Stony loam with peaty layers (1.50 m, units A-B of Rutot)

b Rubified clayey sand with cross-bedding, loaded with pebbles and block of quartz and ardennian rock, eroding the underlying unit (2.50 m, unit C of Rutot)

c yellow fossiliferous sand with limonitic layers and concretions (7 to 10 m, units D to H of Rutot)

d rubified glauconific sand with quartz pebbles, often doubled (0.02 – 0.20 m, unit I of Rutot)

e white and salmon-coloured sand with thin pebble layers (3.50 to 5 m, unit J of Rutot)

f alternating white to yellow-brown sand (6 m, units J to L by Rutot), with black manganiferous nodules (level m – n of Rutot); at 1.50 m above the base horizon with small quartz pebbles et large weathered flint blocks (unit k of Rutot)

g bed of loose flint blocks (>0.30 m, unit M of Rutot).

Units a to b represent the Onx of Liège Formation, units c to d represent the 'Chattian' or the Boncelles Formation sensu stricto, units e to f represent the 'Tongrian' part of the Boncelles Formation sensu lato, unit g represents the clay-with-flints alteration unit but is incorporated in the Boncelles Formation because of its limited thickness.

Sierakowski (1970) adopted the subdivision made by Ancion & Van Leckwijck (1947) and attributed the 'Chattian' part to the upper sand unit and the 'Tongrian' part to the lower and middle sand units of the Oligocene sand deposit (on Figure 0-2), thereby following an informal classification already established by Calembert for internal reports.

The 'Chattian' – 'Tongrian' boundary, approximately in the middle of the Oligocene sand in the Boncelles type locality, originally observed by Rutot (1907, 1908, his horizon I), corresponding to level d of Ancion & Van Leckwijck 1947) has retained the attention in particular of Fourmarier (1931), Macar (1934) and Sierakowski (1970) as a high-energy level, separating the depositional environment of the Oligocene sand between more proximal and more distal.

The Boncelles Formation sensu stricto correlates with the Köln Formation (Kölner Schichten) in the Lower Rhine Graben (Schäfer and Utescher, 2014) and with the Veldhoven Formation in the Campine basin and adjacent Netherlands, more particularly with its lower Voort Member, mainly because of similarity in the Chattian mollusc faunas and the fact that the Voort Sand Member has the widest extent towards the south (Dusar & Vandenberghe, 2020).

Despite the poor dating, the twofold subdivision of the Oligocene sand, either on the eastern Hesbaye plateau or on the Condruzian promontory between Meuse and Ourthe south of Liège and even on the Hautes Fagnes plateau, and their rather constant thicknesses and facies are remarkable features. This suggests the prevalence of the early Savian unconformity, separating the Chattian from the older Oligocene and the effect of the Chattian sea level rise resulting in additional accommodation space (Vandenberghe, 2017; Munsterman & Deckers, 2022). Late Savian tectonics led to a marine regression towards the late Chattian (Munsterman & Deckers, 2022) and coverage by residual gravels of the Liège Formation, probably deposited when the area was still in lowland position (Juvigné et al., 2021b). Uplift of the Ardenno – Rhenish Massif removed most traces of the easily erodible Chattian sand (Demoulin, 1989; Juvigné et al., 2021ab) , except for their actual occurrences where the Oligocene sand is rather completely preserved due to deep weathering of the Cretaceous.

Age

A mollusc fauna occurring in the Boncelles Formation of the type area, first described by Rutot (1907) is characterised by the presence of Meretrix (Callista) beyrichi, considered as a guide fossil for the Chattian. Although some doubts have been raised about this datation because of the poor quality of the fauna and its value for detailed correlations (discussion in Demoulin, 1989) similar faunas have been recorded from the Voort Member of the Veldhoven Formation in the Campine, and cannot be assigned to any other lithostratigraphical unit of different age.

The stratigraphical assignment of the Boncelles Formation to the Oligocene is based on general palaeogeographical assumptions, supported by its heavy mineral association (Thibeau, 1960;

Sierakowski, 1970; Demoulin, 1986, 1987, 1989; Juvigné et al., 2021a). In this way it is not dissociated from the underlying 'Tongrian' Oligocene sand, which is by all authors correlated to the Lower Oligocene Sint-Huibrechts-Hern Formation. Sierakowski (1970), thereby following Macar (1934) insisted on the twofold subdivision of the Oligocene sand in the Boncelles type area, whereas Demoulin (1986, 1987) also recognised two transgressive phases in the Oligocene sand on the Hautes Fagnes plateau and linked these to the subdivision already observed in the Boncelles type area.

No firm Upper Oligocene, Chattian age can be established for the upper unit in the Oligocene sand of the Hautes Fagnes plateau but its link to the Boncelles type area and via this to the eastern Hesbaye plateau makes the attribution to the latest Oligocene transgressive phase and possible connection to the Chattian transgression in the Lower Rhine Graben more plausible, as already postulated by Hager (1980). Whatever more precise datation may reveal, it can be stated that the sediments attributed to the Boncelles Formation sensu stricto - as described in this LIS file - unequivocally represent the latest Oligocene transgression in eastern Belgium.

Dataset

The former sand pit Maurissen in Elst (Millen, commune of Riemst, Fig. 5 in Dusar & Vandenberghe, 2020) is the single site included in the DOV-Neogene data collection, based on its links to the GSB data sheets, more specifically in the datasubset NCS_Neogene 2020_Dusar and Vandenberghe., 2020.

Name	GSB name	DOV name	GSB Collections URL	DOV URL
sand pit Maurissen	107W0304	BGD107W0304	https://collections.naturalsciences.be/ssh-geology-archives/arch/107w/107W0304.pdf	https://www.dov.vlaanderen.be/data 170593

Extra data in this LIS:
The former Sart-Haguet sand pit stratotype for the Boncelles Formation by Rutot (1907) is 134W0011; the different sections in this sand pit described by Ancion & Van Leckwijck (1947) are 134W0312 to 316, 134W0334. The auxiliary stratotype of Les Gonhir by Rutot (1907) is 134W0010 in the GSB data archive.

Name	GSB name	DOV name	GSB Collections URL	DOV URL
Sart-Haguet sand pit	134W0011, 0312 to 0316	-	https://collections.naturalsciences.be/ssh-geology-archives/arch/134w/134w0011.txt , 0312.txt to 0316.txt	-
Les Gonhis sand pit	134W0010	-	https://collections.naturalsciences.be/ssh-geology-archives/arch/134w/134w0010.txt	-

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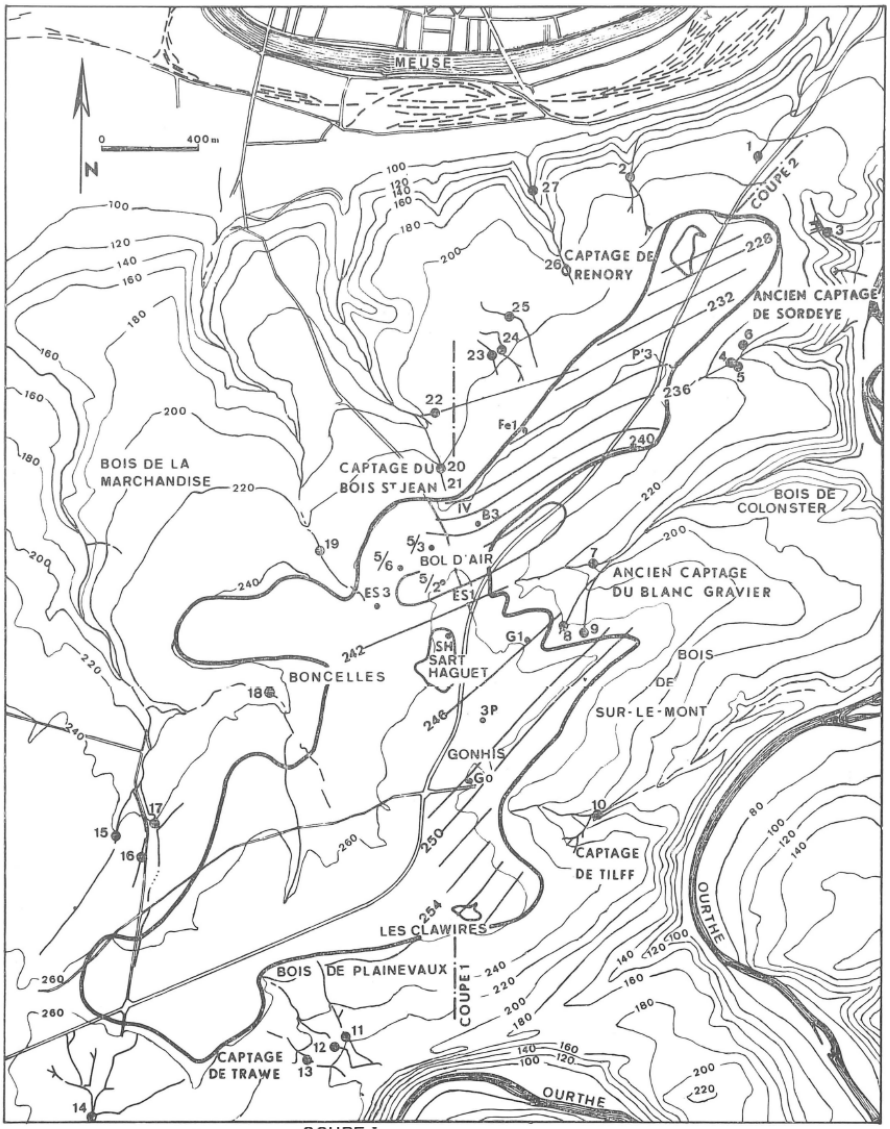


Figure 0-1: Type locality of the Condrusian Boncelles Formation showing the extent of Boncelles Sand on the watershed between Meuse and Ourthe rivers, south of Liège, extending 6 km in N-S direction and 0.3 tot 2.5 km in E-W direction, with location of former Sart-Haguet and Gonhis sand pits (Sierakowski, 1970).

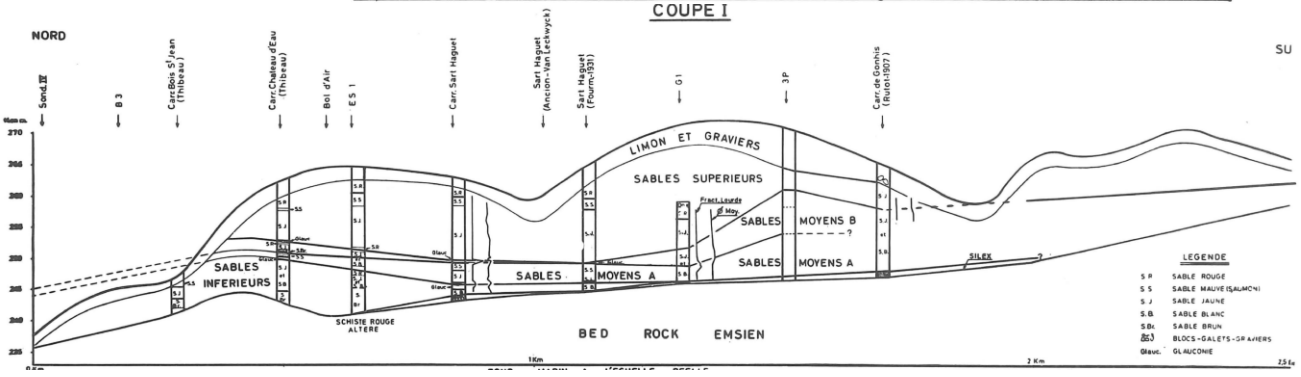


Figure 0-2: North-South cross section across the 'lambeau à sables tertiaries de Boncelles' type locality. The 'sables supérieurs' represent the deposits correlated to the Chattian or the Boncelles Formation sensu stricto, whereas the 'sables moyens et inférieurs' represent its Tongrian part, also included in the Boncelles Formation sensu lato (Sierakowski, 1970).

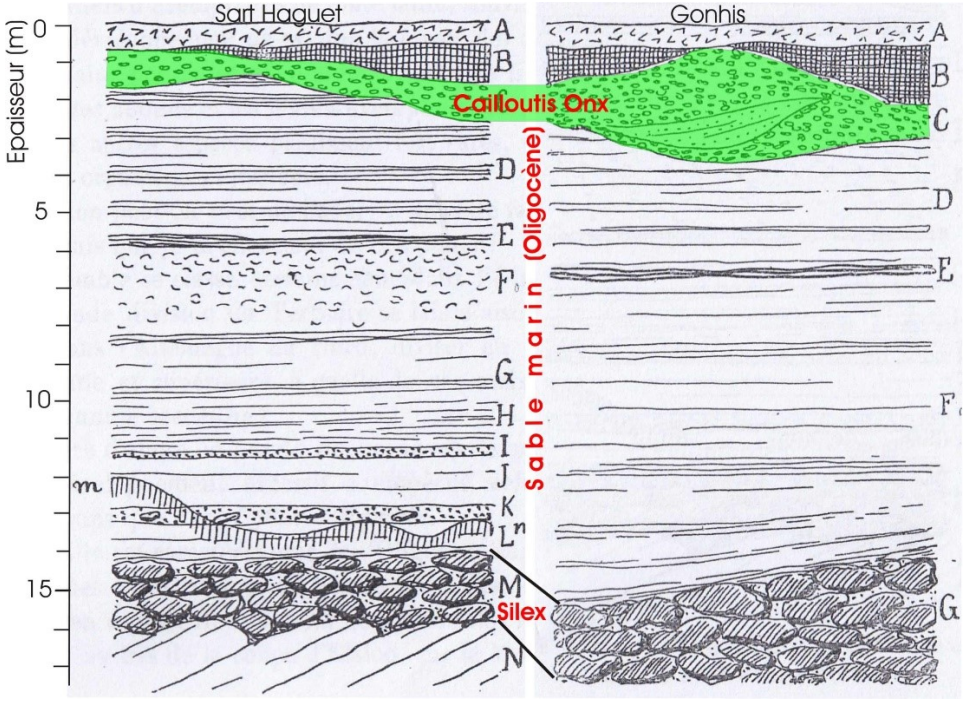


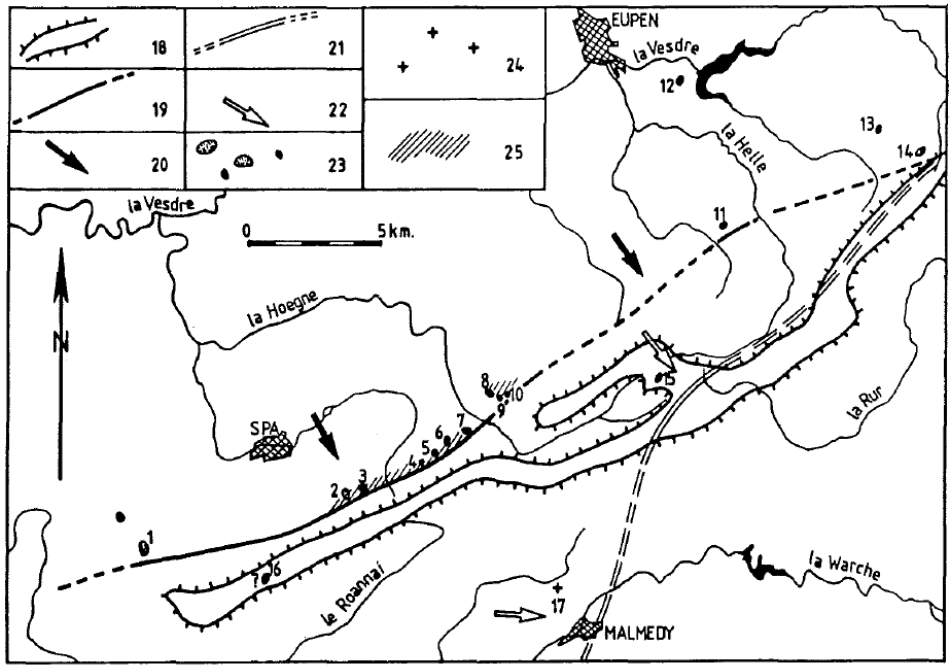
Figure 0-3: Sart-Haguet (134W0011) and Gonhis (Les Gonhir for Rutot, 134W0010) sand pits in the Boncelles type area, 500 m distant in NNW-SSE direction (location on Fig. 1), as surveyed by Rutot (1907, 1908), resumed by Marion et al. (2018). Legend according to Rutot (1907):

A. Actual stony soil (0.40 m)
B. Green water-saturated clay (0 – 1 m)
C. Gravel bed composed of quartz and ardennian siliciclastic rocks, interstratified with red clays and clayey sand (1 – 3 m, marked Cailloutis Onx)
D. Rubified finely-stratified sand with more clayey laminae (3 – 4 m)
E. Limonitised sand around clay layer (0.15 – 0.20 m)
F. Yellow, red-stained fine-grained micaceous stratified sand with decalcified shells (mainly 'Pectunculus' type), abundant in Sart-Haguet (1 to 1.50 m) and rare in Gonhis (10 m)
G. Yellow fine-grained micaceous stratified sand (3 – 4 m in Sart-Haguet, included in F in Gonhis)
H. Fine-grained micaceous well-stratified sand with alternating white and red lauers (2 m in Sart-Haguet, included in F in Gonhis)
I. Thin gravel bed with quartzitic pebbles (0.10 m in Sart-Haguet)
J. Well-stratified sand with 'salmon' colour (2 m in Sart-Haguet)
K. Gravel bed with quartzitic pebbles and large weathered flint (0.20 m in Sart-Haguet)
L. Red-stained greenish sand, bleached towards the base (0.50 m in Sart-Haguet)
M. Large blocks of flint embedded in compacted clayey sand, topped by well-rounded flattened flint pebbles (0.60 to 1 m in Sart-Haguet, unit G at least 1 m thick in Gonhis)
N. Unconformity on Lower Devonian bedrock

m- n weathering front marked by black-stained 'Manganese oxide' above the flint bed.

Units A – C represent the Liège Formation with weathered top, whereby unit C represents the Liège Formation sensu stricto. Units D to L represent the marine Oligocene / undifferentiated sand, grouped in the Condruzian Boncelles Formation, whereby units D – I represent the 'Chattian' part or the Boncelles Formation sensu stricto, and units J to L its 'Tongrian' part. Unit M in Sart-Haguet or G in Gonhis represents the Clay-with-flint alteration unit, overlain by the typical Tongrian basal flint and embedded in stiff clay of variegated colour (marked 'Ona, glaises

plastiques diversement colorées' for les Gonhirs on the old geological map (Forir & Mourlon, 1897).



1. sable de Desnié
2. sable du Bois des Minières
3. sable du Tir Communal
4. sable de Rondfahai
5. sable de Cokaifagne-autoroute
6. sable de la Fagne Damsay
7. sable de Fagnoux-Dupont
8. sable de Solwaster
9. sable du Trou Laurent
10. sable de la Croix du Tapeu
11. sable de Porfays
12. sable d'Eupen
13. sable de la Croix Arnold
14. sable de Konzen
15. sable de la Baraque Michel
16. sable du Rosier
17. sable de Bernister
18. crête des Hautes Fagnes
19. ligne de rivage pendant la plus grande partie de la transgression oligocène
20. provenance de la mer
21. ligne de rivage en fin de transgression oligocène
22. provenance de la mer
23. sable oligocène marin
24. sable continental
25. replat

Figure 0-4: Occurrence of Oligocene sand on the Hautes Fagnes plateau. 19: presumed coast line during the deposition of the lower 'Tongrian' sand; 21: presumed coast line during the latest transgression, during deposition of the upper sand unit, correlated to the Chattian (Demoulin, 1987). The latter coast line must have been farther east to include the Weisser Stein massif (following Demoulin, 1989).